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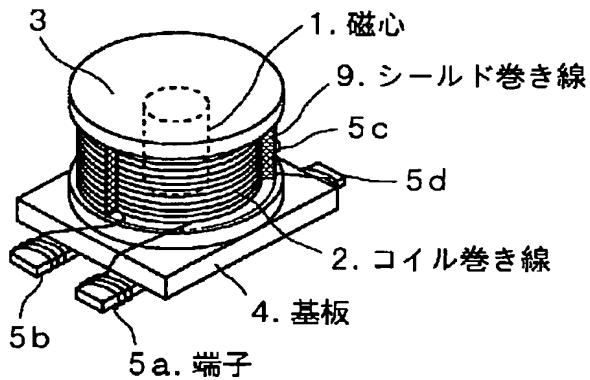
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(54) 【発明の名称】コイルを有する回路部品

(57) 【要約】

【課題】 従来、小型インダクタ等のコイルを有する回路部品を磁気シールドするため、コイルの回りに磁性体の遮蔽リングやシールド・ケースを設けたり、コイルを磁性粉含有樹脂に封入したり、金属フィルムで巻いたりしていたが、これらの構造は部品数が増えたり、寸法が大きくなったり、特殊の材料を用いたり、十分な遮蔽作用が得られなかつたりするものであった。

【解決手段】 磁心1に銅線のコイル巻き線2を巻いた上に、パーマロイ、珪素鋼等の金属磁性体の細線でシールド巻き線9を施し、シールド巻き線9の端末を端子5c、5dに接続する。こうしてシールド巻き線9の層を遮蔽部材にする。シールド巻き線9の材質、線径、巻き数等を選択することによって容易に遮蔽作用を調整でき、高性能で廉価な小型インダクタ等の回路部品を実現できる。



## 【特許請求の範囲】

【請求項1】 コイル巻き線の上に、磁性材料線でシールドをするための巻き線層を設けたことを特徴とするコイルを有する回路部品。

【請求項2】 請求項1に記載のコイルを有する回路部品であって、シールド巻き線の端末を接続した端子を設けたことを特徴とするコイルを有する回路部品。

【請求項3】 請求項1に記載のコイルを有する回路部品であって、コイルを非磁性樹脂でパッケージしたこととするコイルを有する回路部品。

【請求項4】 コイルを有する回路部品が小型インダクタであることを特徴とする請求項1ないし3のいずれか1項に記載のコイルを有する回路部品。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は携帯機器用の小型インダクタ、EL駆動回路用の昇圧コイル、変圧器、モータ部品等のコイルを有する回路部品に関する。

## 【0002】

【従来の技術】 各種の電気、電子回路部品がコイルを構成要素にしているが、例えばコイルからなる部品であるインダクタも、近年、電子回路の表面実装技術の普及に伴って小型のものが多く用いられている。これらの小型インダクタには、部品間の磁気的、電磁的な干渉やコイル同士の相互誘導を防ぐために、種々のシールド構造を施したものがある。図4のものは、フェライト系の粉末磁性体を成形して両端にフランジ3のある磁心1を作り、これにコイル巻き線2を施して基板4に載せ、コイル巻き線2の両端を端子5a、5bに接続したものである。そしてフェライト系の粉末磁性体を成形した環状の遮蔽リング6を、コイルを囲んで基板4に接着し、コイルを磁気シールドしてある。あるいは遮蔽リング6の代わりに金属磁性体で作ったシールド・ケースを設けることもある。

【0003】 図5は、フェライト系の粉末磁性体を成形した丸棒の磁心1にコイル巻き線2を施して、樹脂でパッケージしたインダクタである。樹脂パッケージはフェライト粉末等の磁性材料粉を混入した磁性粉含有樹脂7で、これによって樹脂外装が磁気シールド機能を持っている。図6は、パーマロイ、珪素鋼板等の金属磁性材料板をプレス抜きしたC字形の磁心1にコイル巻き線2を施し、その上に薄い金属フィルム8を巻くことによってシールドしたものである。

## 【0004】

【発明が解決しようとする課題】 これらシールド構造を持つ従来のコイルには次のような問題がある。すなわち図4のものでは、コイルの回りに遮蔽リング6やシールド・ケースを配置するから製品寸法が大きくなる上、構成部品が増え、フランジ3のついた磁心1を磁性材料で成形するのに加えて、遮蔽リング6やシールド・ケース

等をフェライトや金属磁性材料で作るには、別に金型や成形、切削等の工程が必要であってコスト増になる。設計変更があれば新規な金型が必要になって、そのために準備期間を要するとともに部品の種類が増えるなど負担が大きかった。

【0005】 図5の、コイルを樹脂中に封入したインダクタの場合は樹脂の外装がシールド作用を行うが、通常の樹脂材料でなく、高度な樹脂混合技術および成形技術が必要な磁性粉含有樹脂7を用いる必要がある。図6

10 の、コイルに金属フィルム8を巻くものは、シールド層が薄いため用途が時計用モータ等の磁束密度の低いものに限られて、応用範囲を広げることが難しかった。本発明はこれらの問題を解決し、簡便で効果的な磁気シールド構造を持つインダクタ等のコイルを含む回路部品を提供する。

## 【0006】

【課題を解決するための手段】 本発明の回路部品のシールド構造は、磁心に銅線のコイル巻き線を施したコイルの上に、パーマロイ、珪素鋼等の金属磁性材料の細線を20 巻いて端末処理したものである。すなわちコイルの表層に設けた金属磁性材料線層をもってシールド部材にするのである。製作方法としては、まずコイル巻き線を施し、次いで同一の巻き線機によって金属磁性材料線を巻き線する。金属磁性材料線の線径、巻き数の選択と、透磁率、周波数特性等を考慮した材料の選択によりシールド作用を制御することができる。

## 【0007】

【発明の実施の形態】 以下、図面に基づいて本発明の実施形態を説明する。なお、前記の説明を含め、同種の部品や部分については同じ符号を用いることにする。図1は先の図4に類似の小型インダクタに本発明を用いたものである。フェライトを粉末成形し両側にフランジ3を設けた磁心1に、銅線でコイル巻き線2を施し、コイル巻き線2の上にさらにパーマロイ、珪素鋼等の磁性材料の細線を巻いてシールド巻き線9にしたものを基板4に取り付けてある。このシールド巻き線9の層が図4の従来の遮蔽リング6に代わってシールド作用を行うのである。図ではシールド巻き線は一部を切り欠いて示してある。

40 【0008】 基板4には4個の端子5a、5b、5c、5dが設けてあり、例えばコイル巻き線2の両端を端子5a、5bに接続し、シールド巻き線9の両端を端子5c、5dに接続する。シールド巻き線の端子5c、5dは、この小型インダクタを機器の回路基板に実装する際に接地線に接続して、シールド巻き線9の遮蔽作用を安定させる。このようにコイル巻き線2とシールド巻き線9を2層に巻き線する工程は、磁心1を同じ巻き線機に取り付けたまま、2種類の巻き線を順次切り替えて供給することにより、コイル巻き線としてのコイル用銅線を巻いた上にシールド巻き線であるシールド用金属磁性材

料線を巻くことを連続して行うことができる。

【0009】図2は本発明の第2の実施形態で、先の図5のものと同様にフェライト系の粉末磁性体を成形した丸棒の磁心1にコイル巻き線2を施し、その上にシールド巻き線9を設けた小型インダクタで、シールド巻き線9を一部切り欠いて示してある。そして、このように巻いたコイルを樹脂パッケージである封止樹脂10中に封入してパッケージしてある。図5の従来のものでは樹脂外装は磁性材料粉を混入した磁性粉含有樹脂7であったが、図2の本発明ではコイル巻き線2の外側に巻いたシールド巻き線9が遮蔽作用を行なうから、封止樹脂10は磁性を備えた特別の材料でなく、通常のエポキシ系樹脂等の非磁性樹脂であればよい。コイル巻き線用端子5a、5bに加えて、図では見えないが、向こう側の端部にも端子を二つ設けてシールド巻き線9の両端をそれぞれ接続する。

【0010】図3は本発明の第3の実施形態で、磁心1はパーマロイ、珪素鋼等の金属磁性材をI字形にプレス抜きした小型インダクタである。ここでも先の実施形態におけると同様、銅線のコイル巻き線2の上に磁性材料線のシールド巻き線9を施して、これをシールド部材にしてある。この小型インダクタにも4箇所に接続用の端子5a、5b、5c、5dを設けてあるが、これはコイル巻き線2とシールド巻き線9の端末各2本、計4本の巻き線端末を磁心1の両端の4箇所の枝部に巻き付けて、導電接着剤やハンダ付け等で固定したものである。磁心1は表面を絶縁処理した材料であるから、巻き線の端末を巻き付けても短絡を起こすことはない。各巻き線をこのように端末処理することで、この小型インダクタは回路基板への表面実装に適するものになってる。

【0011】図示は省くが、従来、図6のようによくコイル巻き線2に金属フィルム8を巻いて磁気遮蔽していた回路部品についても、本発明に従ってコイル巻き線を施した上にシールド巻き線を設けることにより、有効な遮蔽構造が得られることは先の実施形態と同様である。

【0012】

【発明の効果】以上述べたように、本発明のコイルを有する回路部品の磁気シールド構造は、従来のような遮蔽リングやシールド・ケース等の部材が不要であるから構成部品数が減少し、また、磁性粉含有樹脂等の特殊材料を用いることもない。従ってこれらに関する金型や製造工程が不要でコストが削減されるとともに、小型、薄型化が可能になる。工程的にも通常の巻き線機を使用して製作でき、特別の設備等を必要としない。そしてシールド巻き線の材質、線径、巻き数等を選ぶことにより、容易にシールド作用を制御できるから製品性能の自由度が増し、また設計変更への対応が簡単であって製品の開発期間が短縮される。このように本発明のコイルの遮蔽構造は簡単で機能が優れたものであり、コイルを備えた回路部品である高性能の小型インダクタ等を廉価に提供できるのである。

#### 【図面の簡単な説明】

【図1】本発明を用いた小型インダクタの斜視図である。

【図2】本発明を用いた別の小型インダクタの斜視図である。

【図3】本発明を用いたさらに別の小型インダクタの斜視図である。

【図4】従来の小型インダクタの斜視図である。

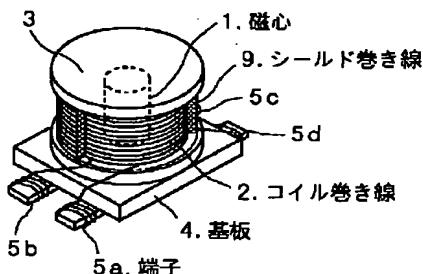
【図5】従来の別の小型インダクタの斜視図である。

【図6】コイルを有する従来の回路部品の斜視図である。

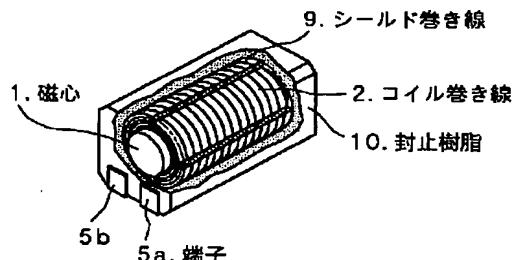
#### 【符号の説明】

- 1 磁心
- 2 コイル巻き線
- 3 基板
- 4 端子
- 5a、5b、5c、5d 端子
- 6 遮蔽リング
- 7 磁性粉含有樹脂
- 8 金属フィルム
- 9 シールド巻き線
- 10 封止樹脂

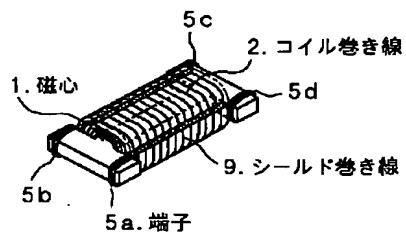
【図1】



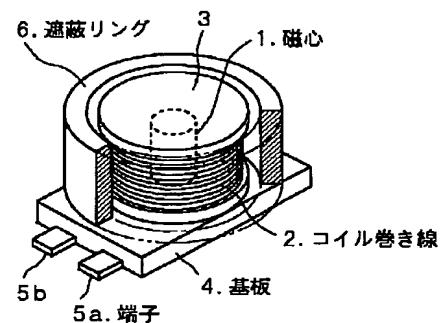
【図2】



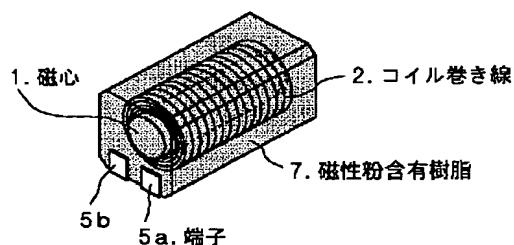
【図3】



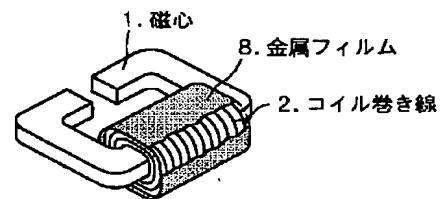
【図4】



【図5】



【図6】



## PATENT ABSTRACTS OF JAPAN

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(21)Application number : 09-366772 (71)Applicant : CITIZEN ELECTRONICS CO LTD

(22)Date of filing : 26.12.1997 (72)Inventor : HORIUCHI MEGUMI

### (54) CIRCUIT COMPONENT WITH COIL

#### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide circuit components including a coil, such as an inductor with simple and effective magnetic shield structure.

**SOLUTION:** A coil winding 2 of a copper wire is wound onto a magnetic core 1, a shield winding 9 is given on it by the thin wire of a metallic magnetic body, such as permalloy, silicon steel, and the terminals of the winding 9 is connected with the terminals 5c and 5d. The layer of the winding 9 is made a shielding member such as this. Shielding operation is adjusted easily by selecting the material, the wire diameter, the winding number, etc., of the winding 9 and the circuit parts of a small inductor, etc., of high performance and a low price are realized.

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#### [Claim(s)]

[Claim 1] Passive circuit elements which have the coil characterized by preparing the winding layer for shielding by the magnetic material line on a coiling line.

[Claim 2] Passive circuit elements which are the passive circuit elements which have a coil according to claim 1, and have the coil characterized by preparing the terminal which connected the terminal of shielding winding.

[Claim 3] Passive circuit elements which are the passive circuit elements which have a coil according to claim 1, and have the coil characterized by packing a coil by nonmagnetic resin.

[Claim 4] Passive circuit elements which have the coil of a publication in claim 1 characterized by the passive circuit elements which have a coil being small inductors thru/or any 1 term of 3.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the passive circuit elements which have coils, such as a booster coil the small inductor for pocket devices, and for EL drive circuits, a transformer, and motor components.

[0002]

[Description of the Prior Art] Although various kinds of electrical and electric equipment and electronic-circuitry components are using the coil as the component, many small things are used also for the inductor which are the components which consist of a coil, for example with the spread of the surface mount technologies of an electronic circuitry in recent years. In order to prevent the magnetic and electromagnetic interference between components, and the mutual induction of coils, there are some which gave various shielding structures in these small inductors. The thing of drawing 4 makes the core 1 which fabricates the powder magnetic substance of a ferrite system and has a flange 3 in both ends, gives this the coiling line 2, puts it on a substrate 4, and connects the both ends of the coiling line 2 to Terminals 5a and 5b. And a coil is surrounded, the annular electric shielding ring 6 which fabricated the powder magnetic substance of a ferrite system is pasted up on a substrate 4, and magnetic shielding of the coil has been carried out. Or the shielding case made from the metal magnetic substance instead of the electric shielding ring 6 may be established.

[0003] Drawing 5 is the inductor which gave the coiling line 2 to the core 1 of the round bar which fabricated the powder magnetic substance of a ferrite system, and packed by resin. A resin package is magnetic powder content resin 7 which mixed magnetic material powder, such as ferrite powder, and resin sheathing has a magnetic-shielding function by this. Drawing 6 gives the coiling line 2 to the core 1 of C typeface which carried out punching of the metal magnetic material plates, such as a permalloy and silicon steel, and shields it by rolling the thin metal film 8 on it.

[0004]

[Problem(s) to be Solved by the Invention] There are the following problems in the conventional coil with these shielding structure. That is, in the thing of drawing 4, since the electric shielding ring 6 and a shielding case are arranged around a coil, when a product dimension becomes large, component parts increase in number, and in order to make the electric shielding ring 6, a shielding case, etc. with a ferrite metallurgy group magnetic material in addition to fabricating the core 1 which the flange 3 attached with a magnetic material, independently, processes, such as metal mold, and shaping, cutting, are required, and become an increase of cost. When the design change occurred, while new metal mold was needed, therefore requiring the preparation period, a burden -- the class of components increases -- was large.

[0005] In the case of the inductor which enclosed the coil of drawing 5 into resin, although sheathing of resin performs a shielding operation, it is necessary to use the magnetic powder content resin 7 which needs not a resin ingredient but a usual advanced resin blending technique and forming technique. Since what winds the metal film 8 around the coil of drawing 6 had the thin shielding layer, it was difficult for it for an application to be restricted to what has the low flux density of the motor for clocks etc., and to extend the application range. This invention solves these problems and offers the passive circuit elements containing coils, such as an inductor with simple and effective magnetic-shielding structure.

[0006]

[Means for Solving the Problem] The shielding structure of the passive circuit elements of this invention coils and carries out terminal treatment of the thin line of metal magnetic materials, such as a permalloy and silicon steel, on the coil which gave the coiling line of copper wire to the core. That is, it is made a shielding member with metal magnetic material \*\*\*\* prepared in the surface of a coil. As the manufacture approach, a coiling line is given first and, subsequently the winding of the metal magnetic material line is carried out by the same winding machine. A shielding operation is controllable by the wire size of a metal magnetic material line, selection of a number of turns, and selection of the ingredient in consideration of permeability, frequency characteristics, etc.

[0007]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing. In addition, about components and a part of the same kind, the same sign will be used including the aforementioned explanation. Drawing 1 uses this invention for a small inductor similar to previous drawing 4 . What gave the coiling line 2 with copper wire, coiled the thin line of magnetic materials, such as a permalloy and silicon steel, further on the coiling line 2, and was made into shielding winding 9 in the core 1 which carried out powder molding of the ferrite and formed the flange 3 in both sides is attached in the substrate 4. The layer of this shielding winding 9 performs a shielding operation instead of the conventional electric shielding ring 6 of drawing 4 . By a diagram, shielding winding cuts a part, and has lacked and shown it.

[0008] Four terminals 5a, 5b, 5c, and 5d are formed in the substrate 4, for example, the both ends of the coiling line 2 are connected to Terminals 5a and 5b, and the both ends of shielding winding 9 are connected to Terminals 5c and 5d. In case this small inductor is mounted in the circuit board of a device, it connects with a grounding conductor, and the terminals 5c and 5d of shielding winding stabilize the screening of shielding winding 9. thus, shielding which the copper wire for coils as a coiling line was coiled upwards, and is shielding winding when the process which carries out the winding of the coiling line 2 and the shielding winding 9 to two-layer changes two kinds of winding one by one and supplies it, attaching a core 1 in the same winding machine -- public funds -- it can perform coiling a group magnetic material line continuously.

[0009] Drawing 2 gives the coiling line 2 to the core 1 of the round bar which is the 2nd operation gestalt of this invention and fabricated the powder magnetic substance of a ferrite system like the thing of previous drawing 5  $R > 5$ , it is the small inductor which formed shielding winding 9 on it, and cuts shielding winding 9 in part, and has lacked and shown it. And the coil rolled in this way is enclosed into the closure resin 10 which is a resin package, and it has packed. Although resin sheathing was magnetic powder content resin 7 which mixed magnetic material powder in the conventional thing of drawing 5 , since the shielding winding 9 coiled around the outside of the coiling line 2 in this invention of drawing 2 performs screening, closure resin 10 should just be nonmagnetic resin, such as usual epoxy system resin instead of the special ingredient equipped with magnetism. In addition to the terminals 5a and 5b for coiling lines, it is not visible by a diagram, but two terminals are prepared also in the edge of the other side, and the both ends of shielding winding 9 are connected, respectively.

[0010] Drawing 3 is the 3rd operation gestalt of this invention, and a core 1 is the small inductor which carried out punching of the metal magnetism material, such as a

permalloy and silicon steel, to I-shape. In the previous operation gestalt, similarly, the shielding winding 9 of a magnetic material line is given on the coiling line 2 of copper wire, and this is made into the shielding member also here. Although the terminals 5a, 5b, 5c, and 5d for connection are formed also in this small inductor at four places, this twists two terminals each of the coiling line 2 and shielding winding 9, and a total of four winding terminals around four branches of the both ends of a core 1, and fixes them with electric conduction adhesives, soldering, etc. Since a core 1 is the ingredient which carried out insulating processing of the front face, even if it twists the terminal of winding, it does not cause a short circuit. By carrying out terminal treatment of each winding in this way, this small inductor is suitable for the surface mount to the circuit board.

[0011] Although illustration is excluded, it is the same as that of a previous operation gestalt that effective electric shielding structure is acquired by having given the coiling line upwards according to this invention also with the passive circuit elements which were rolling and carrying out magnetic shielding of the metal film 8 to the coiling line 2 like drawing 6 , and preparing shielding winding conventionally.

[0012]

[Effect of the Invention] As stated above, since the members, such as an electric shielding ring like before and a shielding case, are unnecessary, the number of component parts decreases, and exotic materials, such as magnetic powder content resin, are not used for the magnetic-shielding structure of the passive circuit elements which have the coil of this invention. Therefore, small and thin shape-ization are attained, while the metal mold and the production process about these are unnecessary and cost is reduced. It can manufacture using a winding machine usual also in process, and a special facility etc. is not needed. And by choosing the quality of the material of shielding winding, a wire size, a number of turns, etc., since a shielding operation is easily controllable, the correspondence to the increase of a degree of freedom and the design change of product performance is easy, and the development cycle of a product is shortened. Thus, the electric shielding structure of the coil of this invention is easy, a function is excellent, and the small inductor of the high performance which is passive circuit elements equipped with the coil etc. can be offered at a low price.

[Field of the Invention] This invention relates to the passive circuit elements which have coils, such as a booster coil the small inductor for pocket devices, and for EL drive circuits, a transformer, and motor components.

[Description of the Prior Art] Although various kinds of electrical and electric equipment and electronic-circuitry components are using the coil as the component, many small things are used also for the inductor which are the components which consist of a coil, for example with the spread of the surface mount technologies of an electronic circuitry in recent years. In order to prevent the magnetic and electromagnetic interference between components, and the mutual induction of coils, there are some which gave various shielding structures in these small inductors. The thing of drawing 4 makes the core 1 which fabricates the powder magnetic substance of a ferrite system and has a flange 3 in both ends, gives this the coiling line 2, puts it on a substrate 4, and

connects the both ends of the coiling line 2 to Terminals 5a and 5b. And a coil is surrounded, the annular electric shielding ring 6 which fabricated the powder magnetic substance of a ferrite system is pasted up on a substrate 4, and magnetic shielding of the coil has been carried out. Or the shielding case made from the metal magnetic substance instead of the electric shielding ring 6 may be established.

[0003] Drawing 5 is the inductor which gave the coiling line 2 to the core 1 of the round bar which fabricated the powder magnetic substance of a ferrite system, and packed by resin. A resin package is magnetic powder content resin 7 which mixed magnetic material powder, such as ferrite powder, and resin sheathing has a magnetic-shielding function by this. Drawing 6 gives the coiling line 2 to the core 1 of C typeface which carried out punching of the metal magnetic material plates, such as a permalloy and silicon steel, and shields it by rolling the thin metal film 8 on it.

[Problem(s) to be Solved by the Invention] There are the following problems in the conventional coil with these shielding structure. That is, in the thing of drawing 4, since the electric shielding ring 6 and a shielding case are arranged around a coil, when a product dimension becomes large, component parts increase in number, and in order to make the electric shielding ring 6, a shielding case, etc. with a ferrite metallurgy group magnetic material in addition to fabricating the core 1 which the flange 3 attached with a magnetic material, independently, processes, such as metal mold, and shaping, cutting, are required, and become an increase of cost. When the design change occurred, while new metal mold was needed, therefore requiring the preparation period, a burden -- the class of components increases -- was large.

[0005] In the case of the inductor which enclosed the coil of drawing 5 into resin, although sheathing of resin performs a shielding operation, it is necessary to use the magnetic powder content resin 7 which needs not a resin ingredient but a usual advanced resin blending technique and forming technique. Since what winds the metal film 8 around the coil of drawing 6 had the thin shielding layer, it was difficult for it for an application to be restricted to what has the low flux density of the motor for clocks etc., and to extend the application range. This invention solves these problems and offers the passive circuit elements containing coils, such as an inductor with simple and effective magnetic-shielding structure.

[Means for Solving the Problem] The shielding structure of the passive circuit elements of this invention coils and carries out terminal treatment of the thin line of metal magnetic materials, such as a permalloy and silicon steel, on the coil which gave the coiling line of copper wire to the core. That is, it is made a shielding member with metal magnetic material \*\*\*\* prepared in the surface of a coil. As the manufacture approach, a coiling line is given first and, subsequently the winding of the metal magnetic material line is carried out by the same winding machine. A shielding operation is controllable by the wire size of a metal magnetic material line, selection of a number of turns, and selection of the ingredient in consideration of permeability, frequency characteristics, etc.

[0007]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing. In addition, about components and a part of the same kind, the same sign will be used including the aforementioned explanation. Drawing 1 uses this invention for a small inductor similar to previous drawing 4. What gave the coiling line 2 with copper wire, coiled the thin line of magnetic materials, such as a permalloy and silicon steel, further on the coiling line 2, and was made into shielding winding 9 in the core 1 which carried out powder molding of the ferrite and formed the flange 3 in both sides is attached in the substrate 4. The layer of this shielding winding 9 performs a shielding operation instead of the conventional electric shielding ring 6 of drawing 4. By a diagram, shielding winding cuts a part, and has lacked and shown it. [0008] Four terminals 5a, 5b, 5c, and 5d are formed in the substrate 4, for example, the both ends of the coiling line 2 are connected to Terminals 5a and 5b, and the both ends of shielding winding 9 are connected to Terminals 5c and 5d. In case this small inductor is mounted in the circuit board of a device, it connects with a grounding conductor, and the terminals 5c and 5d of shielding winding stabilize the screening of shielding winding 9. thus, shielding which the copper wire for coils as a coiling line was coiled upwards, and is shielding winding when the process which carries out the winding of the coiling line 2 and the shielding winding 9 to two-layer changes two kinds of winding one by one and supplies it, attaching a core 1 in the same winding machine -- public funds -- it can perform coiling a group magnetic material line continuously.

[0009] Drawing 2 gives the coiling line 2 to the core 1 of the round bar which is the 2nd operation gestalt of this invention and fabricated the powder magnetic substance of a ferrite system like the thing of previous drawing 5  $R > 5$ , it is the small inductor which formed shielding winding 9 on it, and cuts shielding winding 9 in part, and has lacked and shown it. And the coil rolled in this way is enclosed into the closure resin 10 which is a resin package, and it has packed. Although resin sheathing was magnetic powder content resin 7 which mixed magnetic material powder in the conventional thing of drawing 5, since the shielding winding 9 coiled around the outside of the coiling line 2 in this invention of drawing 2 performs screening, closure resin 10 should just be nonmagnetic resin, such as usual epoxy system resin instead of the special ingredient equipped with magnetism. In addition to the terminals 5a and 5b for coiling lines, it is not visible by a diagram, but two terminals are prepared also in the edge of the other side, and the both ends of shielding winding 9 are connected, respectively.

[0010] Drawing 3 is the 3rd operation gestalt of this invention, and a core 1 is the small inductor which carried out punching of the metal magnetism material, such as a permalloy and silicon steel, to I-shape. In the previous operation gestalt, similarly, the shielding winding 9 of a magnetic material line is given on the coiling line 2 of copper wire, and this is made into the shielding member also here. Although the terminals 5a, 5b, 5c, and 5d for connection are formed also in this small inductor at four places, this twists two terminals each of the coiling line 2 and shielding winding 9, and a total of four winding terminals around four branches of the both ends of a core 1, and fixes them with electric conduction adhesives, soldering, etc. Since a core 1 is the ingredient which carried out insulating processing of the front face, even if it twists the terminal of winding, it does not cause a short circuit. By carrying out terminal treatment of each winding in this way, this small inductor is suitable for the surface mount to the circuit board.

[0011] Although illustration is excluded, it is the same as that of a previous operation gestalt that effective electric shielding structure is acquired by having given the coiling line upwards according to this invention also with the passive circuit elements which were rolling and carrying out magnetic shielding of the metal film 8 to the coiling line 2 like drawing 6 , and preparing shielding winding conventionally.

[0012]

**[Brief Description of the Drawings]**

[Drawing 1] It is the perspective view of the small inductor using this invention.

[Drawing 2] It is the perspective view of another small inductor using this invention.

[Drawing 3] It is the perspective view of another small inductor to the pan using this invention.

[Drawing 4] It is the perspective view of the conventional small inductor.

[Drawing 5] It is the perspective view of another conventional small inductor.

[Drawing 6] It is the perspective view of the conventional passive circuit elements which have a coil.

**[Description of Notations]**

1 Core

2 Coiling Line

4 Substrate

5a, 5b, 5c, 5d Terminal

6 Electric Shielding Ring

7 Magnetic Powder Content Resin

8 Metal Film

9 Shielding Winding

10 Closure Resin

## PATENT ABSTRACTS

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Application number : 1979-076625

Applicant : Tateisi Electronics Co.

Date of filing : 18.06.1979

Inventor : Yamasaki, Hiroyuki

Title : Proximity switch

### Abstract

A high-frequency oscillation type proximity switch comprising a resonance circuit in which a detection coil is used as a pickup for sensing the approach of an object thereto and a resonance capacitor is disposed at a position very close to the detection coil so that the resistance of a cable connecting the resonance circuit to its associated oscillation circuit can be substantially ignored in the resonance circuit.

Number of Claims : 3

### Claims

1. A proximity switch, comprising:

a detection coil having a core, said core having a front and a back surface;  
a capacitor disposed on the back surface of said core and electrically connected to said detection coil to form a resonance circuit;  
an oscillation circuit is operative connection with said resonance circuit;  
an electrostatic shield surrounding said oscillation circuit;  
a long, narrow, insulating member;  
said resonance circuit and said oscillator circuit with said shield being arranged in a narrow, linear relationship and being disposed inside of said insulating member;  
a narrow housing, said resonance circuit, oscillation circuit, electrostatic shield, and insulating member comprising a single assembly disposed within said housing.

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